Fossil Energy Research & Development

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
FOSSIL ENERGY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands, Narrative in whole dollars)

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

PROGRAM MISSION

Program Mission

The mission of the Fossil Energy (FE) Research and Development (R&D) program is to stimulate sustainable development and utilization of the nation's fossil fuel resources and technologies to assure an ample, secure, clean and low cost domestic supply of energy. This mission will be executed in a way that: assures U.S. global leadership in fossil energy technology; protects the local, regional and global environment; merits public trust; promotes public-private partnerships; creates U.S. jobs; and, contributes to a stronger economy.

Program Overview

The U.S. is reliant on fossil fuels for about 85% of the energy it consumes. Many forecast that relatively low fossil fuel prices and high U.S. reliance on these fuels will continue for decades. Accordingly, a key goal of the Department's fossil energy activities is to ensure that economic benefits from low-priced fossil fuels and a strong domestic industry that creates export-related jobs do not come with unacceptable environmental costs or energy security risks.

To be successful, Federally funded and developed technologies and related analysis need to be transferred into commercial applications. This will be accomplished through joint partnerships with industry utilizing a variety of mechanisms including cost-shared contracts, targeted outreach activities, and cooperative research and development agreements with the Department's Federal Energy Technology Center and National Laboratories.

Key inputs for directing the future of FE gas and oil activities are survey results from the National Petroleum Council study "Research, Development, and Demonstration Needs of the Oil and Gas Industry" and the Petroleum Technology Transfer Council Needs Assessment. These surveys identify potential high benefit R&D areas, considering the near- and long-term needs of both the supply and

utilization sectors, where industry respondents, for a variety of reasons, do not believe the oil and gas industries will make adequate progress on their own.

In FY 1998, $103.0 million is requested for natural gas activities. EIA, in its 1997 Annual Energy Outlook (97AEO), projects a 40 percent increase in domestic natural gas consumption by 2015, nearly 60 percent for electric power generation. This will require increasing amounts of gas to be drawn from parts of the vast domestic resource base that are not currently economical to recover due to the geological setting, quality of the gas, or location relative to infrastructure. The gas program focuses on technical and market needs, and is closely coordinated with efforts by the Gas Research Institute (the research arm of the natural gas industry), other industry energy research, and related research in DOE's Office of Energy Efficiency and Renewable Energy and Office of Energy Research. The program has been developed using a systems approach that spans the entire natural gas fuel cycle from reservoir to end use.

FY 1998 will continue a strong emphasis on development of advanced, super-clean, high efficiency power generation systems utilizing both our abundant natural gas and coal resources. These systems hold the promise of significant greenhouse gas reductions. In FY 1998, under the Advanced Gas Turbine Systems Program, DOE will decide whether to initiate the demonstration phase based on the development of critical technologies and components. Under the Fuel Cells Program, system and stack improvements and cost reduction through improved components and new concepts will continue for distributed and on-site applications.

The natural gas fuel supply activities seek to ensure long-term availability of natural gas at reasonable prices and are carried out under the areas of exploration and production, storage, processing and environment. Under the exploration and production program, activities continue primarily in the development and application of more cost effective advanced drilling technology, as well as resource assessment methodology and reservoir characterization technology to enhance the economic producibility of large volume, low permeability reservoirs. Technology advancement in exploration and production activities is needed to ensure that adequate natural gas reserves and deliverability will be available to meet the increasing demand for natural gas. Storage activities focus on technologies and engineering techniques designed to increase the efficiency and reliability of natural gas during periods of high natural gas demand. New and advanced operational, diagnostic, and analytical technologies and advanced gas flow measurement systems are the key to increasing storage system deliverability, capacity, and mitigating unaccounted-for gas losses of storage inventory.

Gas processing activities focus on development of more efficient processes to upgrade the estimated 300 Tcf of domestic natural gas resources that are low-quality and do not meet pipeline standards. Gas-to-liquids conversion efforts are developing promising technology to utilize shut-in, remote gas resources in Alaska and the Gulf of Mexico. Another key objective of this technology program is to provide clean transportation fuels that are competitive with oil-based fuels.

PROGRAM MISSION - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

In FY 1998 $52.2 million is requested for petroleum activities. Oil R&D activities seek to enhance energy security through increased domestic production, as well as helping the U.S. to be a responsible steward of its oil resources. Marginally economic wells with high remaining resource potential, but low profitability, are being abandoned at an alarming rate. The cumulative impact is that tens of billions of barrels of oil may never be economically producible. The combined impact of FE R&D could contribute toward preserving the availability of these resources, extending reservoir life, and increasing domestic production by nearly 295 million barrels/year by 2010, offsetting equivalent amounts of imports.

Oil R&D includes supporting research and field demonstrations focused on reservoir life extension. The program funds research in the following areas: the development of imaging and diagnostic systems for exploration; reservoir characterization; advanced drilling, completion, and stimulation systems; extraction; and an aggressive technology transfer program to convey to industry methods for extending reservoir life. These technologies are expected to increase annual oil production by 109 million barrels in 2000, save 25,000 high paying jobs by 2005, and contribute $14.5 billion in additional revenues by 2010.

Emerging processing and utilization technologies will build on former program efforts directed toward improving utilization of lower quality crudes through heavy oil and residuum upgrading. This approach reflects the need to overcome West Coast refinery capacity limitations in the ability to effectively upgrade shut-in California heavy oils to lighter products, and needs set forth in the Domestic Natural Gas and Oil Initiative to foster industry adoption of more efficient and environmentally compliant processes and operating practices. By 2015 these activities are expected to decrease oil imports by 480 million cumulative barrels and save $1.1 billion in oil processing costs. Environmental benefits are estimated to include reductions of 16 million tons of CO2 emissions, 1,250 tons of ammonia, and a 2.5% decrease in coke production.

Environmental research activities, which are conducted under both the gas and oil programs, will contribute credible scientific information and advanced technologies to address high priority environmental issues that have been identified by industry and state and federal regulators. In FY 1998, the program will focus on detection and control of air emissions from gas and oil equipment and facilities, treatment of produced water to meet environmental standards, remediation of soils that have been contaminated with hydrocarbons or produced water, treatment and disposal of wastes containing naturally occurring radioactive materials, underground injection of produced water, and other approaches to manage oil and gas field wastes. The program will also implement, together with states and industry, on-line expert systems for environmental permitting and reporting that can save both producers and state regulators

time and money. Through these activities with state governments and industry, the gas and oil environmental program can contribute toward decreasing cumulative industry compliance costs, between now and 2010, by as much as $16 billion, increase gas production by 900 billion cubic feet per year, retain production of up to 60,000 barrels per day of oil that would otherwise be abandoned, increase federal and state revenues by over $8 billion, and add 11,000 jobs to the economy by 2010.

The FY 1998 request for coal is $100.0 million. The coal program responds to the energy and environmental demands of the post-2000 domestic market, and helps U.S. industry to respond to a currently large and growing export market, while contributing to national energy security. In this timeframe, sulfur dioxide (S02) emissions will be capped; permissible nitrogen oxide (NOx) emissions will be in the single digit parts per million levels for much of the country; allowable particulate emissions may be minimal because of air toxic considerations and concerns about health effects of very small particulates; there will be increased pressure to ensure that solid residue resultant from power generation systems are useable byproducts rather than wastes; and international pressure to reduce greenhouse gas emissions, principally carbon dioxide (CO2), will likely increase. In the export arena, energy growth will be predominately in developing countries that heavily rely on coal by necessity. With regard to energy security, our growing dependency on oil imports must be balanced by prudent alternatives that can mitigate and deter disruptions in the supply of liquid fuels.

In response to these priorities, the coal program is focused on three goals. The first is to develop progressively higher efficiency power generation systems with 10-20% lower busbar electricity costs, that significantly reduce CO2, and ultimately near zero levels of pollutants. The second goal is to develop super-clean emission control systems for SO2, NOx (70% to 90% reduction at a fraction of today's cost), air toxics (90% reduction), and particulate matter that can be applied to existing plants. The third goal is to develop economically competitive technologies for the production of alternative transportation fuels and chemicals.

Significant progress towards achieving these goals will be made in FY 1998 through a number of ongoing projects in the Clean Coal Technology Demonstration Program. Three advanced integrated gasification combined cycle (IGCC) facilities will be operating to provide clean power with new technology. A second generation pressurized circulating fluidized bed combustion facility will be under construction and the data needed to evaluate the comparative merits of nineteen advanced environmental control devices just recently demonstrated will be available. Finally, the first demonstration plant to produce alternative transportation fuels and chemicals by means of the innovative liquid phase methanol process will be starting operation.

The major share of FY 1998 funding in coal R&D will be focused on advanced power generation systems (i.e., advanced pulverized

coal-fired systems, indirect-fired cycles, IGCC, and pressurized fluidized-bed (PFB) combustion) that can achieve efficiencies in the 42-45 percent range in the 2000-2005 period, and will provide the engineering foundation for system efficiencies in the 55-60 percent range. These improvements could reduce CO2 emissions by over 40 percent compared to current coal-fired systems. Construction of a proof-of-concept facility will begin in support of the advanced pulverized coal-fired systems development. The engineering development and testing phase of the indirect-fired cycles program will continue. Long term testing will be conducted on the transport reactor train and hot gas particulate controls for IGCC at the Wilsonville Power Systems Development Facility (PSDF). Operation of a product development unit for desulfurization will continue along with R&D and testing of other novel and advanced sulfur sorbents and systems for IGCC.

Also at the Wilsonville facility, operation of an advanced PFB pilot scale project will begin as well as the initial shakedown testing of a PFB pilot scale second generation system. Systems and materials testing and evaluation for performance improvement and cost reductions for PFB will also continue.

The Coal R&D Program is linked to the Clean Coal Technology Program by development, delivery, and refinement of subsystems critical to the technology system demonstrations; and continuing research in key areas that serve to support problem solving during demonstration and enhance the economics and environmental performance needed for market entry. Also, the advanced coal-fueled power system development effort is coupled to that of the Advanced Turbine and Fuel Cell development in that achievement of ultimate performance objectives for coal-fueled systems will require these components.

Significant potential benefits can be realized from achieving the power systems and environmental systems goals. Reductions in the cost of electricity can amount to $5 to $15 billions in savings per year to consumers. The global sales of U.S. industry's advanced power systems can reap revenues of $200 billion based on only 20% of the projected $1 trillion world power equipment market, and could support more than 3 million jobs-years over three decades. Achieving the environmental goal will lower NOx and hazardous air pollutants by 70 to 90 percent while reducing existing and future environmental compliance costs, thereby producing savings of over $7 billion per year to the U.S. industry.

Advanced Clean Fuels Research focuses on technologies for producing clean, economically competitive coal-derived liquids. The aim is to develop environmentally superior processes for transportation and boiler (utility, industrial and commercial application) fuels and chemical feedstocks which can compete with petroleum crude at $20 per barrel by the year 2010. The 97AEO reference case projects

that in 2010 imported oil will be priced at about $20 per barrel, and the U.S. will import 60 percent of its petroleum. If the availability of a potentially large-scale, alternative supply of liquid fuels were able to depress oil prices by $0.50/barrel, the yearly cost saving to U.S. consumers in 2010 would be over $3.5 billion. Categories within this decision unit include: Coal Preparation, Direct and Indirect Liquefaction, and Advanced Research and Environmental Technology. Part of the coal R&D strategy will include studies to probe research areas that focus on major technological challenges that may provide early breakthroughs to allow these goals to be achieved faster, better and cheaper.

In the area of environment, safety and health (ES&H), significant compliance deficiencies have been identified at the FE R&D facilities, as well as at off-site locations where R&D projects were sponsored. FY 1998 funding is targeted at corrective actions to ensure that the FE R&D facilities are operating in compliance with Federal, state and local ES&H requirements, and that the environmental contamination associated with the off-site locations is remediated. The major share of funding will focus on environmental remediation, fire protection, ventilation, industrial safety, control of hazardous materials and protection of water quality. A sustained commitment to ES&H is an important factor in retaining public trust in the conduct of FE activities.

The FY 1998 request for Program Direction and Management Support is $62.8 million. The FY 1998 request recognizes the important role of the Federal Energy Technology Center in the FE program and the need to fund the sites at a level consistent with program goals. FE also promotes the development of interfuel competition and markets for U.S. natural gas and electricity through regulation of natural gas imports and exports and electricity exports by the Fuels Program.

Relative to international activities, FE is taking steps to ensure that the U.S. benefits directly from cooperative research with foreign governments and multilateral institutions as well as enhanced international regulatory coordination. FE is also working with other Departmental groups, Federal agencies, international organizations and private sector companies to promote the export of domestic fossil fuel technology.

Consistent with the R&D goals of the Department, the materials program at Albany, which was formerly associated with the U.S. Bureau of Mines, is being directed at research which will conserve materials produced from minerals. The program will be coordinated with not only Fossil Energy materials R&D but also the materials research at DOE's Office of Energy Efficiency and Renewables and Office of Energy Research. With this coordination, the Department will avoid a duplication of effort and also take full advantage of the unique expertise at the Albany Center which has focused on the full life cycle of materials.

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

PROGRAM FUNDING PROFILE

Sub-program	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Base	FY 1998 Request	Program Change vs Base Dollar	Program Change vs Base Percent
Coal						
Advanced Clean Fuels Research						
Operating Expenses	$ 19,310	$ 16,154	$ 16,154	$ 15,844	$ -310	-2%
Advanced Clean/Efficient Power Systems						
Operating Expenses	$ 79,244	$ 69,269	$ 69,269	$ 66,340	$ -2,929	-4%
Advanced Research and Technology Development						
Operating Expenses	$ 21,072	$ 17,623	$ 17,623	$ 19,729	$ +2,106	+12%
Transfer to Cooperative R&D (TBD)						
Operating Expenses	$ 0	$ 0	$ 0	$ -1,864	$ -1,864	1,000%
Subtotal, Coal	$ 119,626	$ 103,046	$ 103,046	$ 100,049	$ -2,997	-3%
Gas						
Natural Gas Research						
Operating Expenses	$ 58,553	$ 70,214	$ 70,214	$ 56,692	$ -13,522	-19%
Fuel Cells						
Operating Expenses	$ 51,237	$ 50,117	$ 50,117	$ 46,291	$ -3,826	-8%
Subtotal, Gas	$ 109,790	$ 120,331	$ 120,331	$ 102,983	$ -17,348	-14%
Petroleum						
Oil Technology						
Operating Expenses	$ 54,935	$ 45,937	$ 45,937	$ 52,169	$ +6,232	+14%
Subtotal, Petroleum	$ 54,935	$ 45,937	$ 45,937	$ 52,169	$ +6,232	+14%
Program Direction and Management Support (a)						
Operating Expenses	$ 71,269	$ 68,710	$ 68,710	$ 62,766	$-5,944	-9%
Plant and Capital Equipment						
Capital Equipment	$ 1,701	$ 0	$ 0	$ 0	$ 0	0%
Construction	2,304	2,000	2,000	2,532	+532	+27%

PROGRAM FUNDING PROFILE - FOSSIL ENERGY RESEARCH AND DEVELOPMENT (Cont'd)

Sub-program	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Base	FY 1998 Request	Request vs Base Dollar	Request vs Base Percent
Subtotal,Plant and Capital Equipment	$ 4,005	$ 2,000	$ 2,000	$ 2,532	$ +532	+27%
Cooperative Research and Development						
Operating Expenses	$ 6,152	$ 5,566	$ 5,566	$ 5,836	$ +270	+5%
Fossil Energy Environmental Restoration						
Operating Expenses	$ 14,554	$ 13,027	$ 13,027	$ 12,935	$ -92	-1%
Fuels Program						
Operating Expenses	$ 2,687	$ 2,188	$ 2,188	$ 2,173	$ -15	-1%
Mining Research and Development						
Operating Expenses	$ 44,109	$ 5,000	$ 5,000	$ 4,965	$ -35	-1%
Use of Prior Year Balances and Other Adjustments						
Operating Expenses	$ -7,554	$ -1,101	$ -1,101	$ 0	$ +1,101	+100%
Total	$ 419,573	$ 364,704	$ 364,704	$ 346,408	$ -18,296	-5%
Summary						
Operating Expenses	$ 415,568	$ 362,704	$ 362,704	$ 343,876	$-18,828	-5%
Capital Equipment	1,701	0	0	0	0	0%
Construction	2,304	2,000	2,000	2,532	+532	+27%
Total Program	$ 419,573	$ 364,704	$ 364,704	$ 346,408	$-18,296	-5%
Staffing (FTEs)						
Headquarters	129	116	116	114		
Field	1,045	575	575	569		
Total Staffing	1,174	691	691	683		

(A)For comparability includes $4,328,000 for Working Capital Fund in FY 1996.

Authorizations:
P.L. 95-91, "Department of Energy Organization Act" (1977)